

Claims

1. A method for starting a sensorless, electronically commutable direct current motor, having a permanent-magnetically excited rotor and a stator that carries a multi-phase, in particular three-phase stator winding, as well as having a switching device, controlled by a control device, for supplying current in the correct order to the phase windings of the stator from a direct voltage source, characterized in that at rotor standstill and at the onset of the startup operation in the range below a minimum value of the rotor rpm, first the position of the rotor (24) is ascertained by the control device (54), and then via the switching device (14), a regulated initial supply of current to the phase windings (U, V, W) of the stator (22) is effected, while after the predetermined minimum value of the rotor rpm is attained, the control device (54) receives position signals ($\int U_3$) as rotor position signals for a self-commutation of the motor, which signals are derived directly from the third and/or further odd-numbered harmonics of the phase voltages, and from these position signals furnishes control signals to the switching device (14) for supplying current to the phase windings (U, V, W) in normal operation.

2. The method as defined by claim 1, characterized in that at rotor standstill, the control device (54) applies current pulses to the phase windings (U, V, W) of the stator and, from the current rise in the individual windings, ascertains the resting position of the rotor (24).

3. The method as defined by claim 1, characterized in that the duration and/or the amount of the initial supply of current to the phase windings (U, V, W) of the stator (22) is adapted to the load on the motor at the time.

4. The method as defined by one of the foregoing claims, characterized in that the third and/or the further odd-numbered harmonics of the phase voltages of the stator (22) are delivered, on the one hand via the star point (28) of the phase windings (U, V, W) and on the other via an auxiliary star point (30), formed of three phase resistors (32, 34, 36), to a comparator (40) with a downstream integrator (46).

5. The method as defined by claim 4, characterized in that the output signal of the integrator (46), when the motor is at a standstill and at the onset of the startup operation, is delivered to the control device (54) via an A/D converter (50) and in the range above the predetermined minimum value of the rotor rpm via a comparator (52) with hysteresis.

6. The method as defined by one of the foregoing claims, characterized in that the control device (54) has a microcontroller (μC), which as input signals receives the signals of an A/D converter (50), a comparator (52) with hysteresis, and a rated rpm signal (56), and with its outputs, via a driver stage (62), it controls a switching device (14) for supplying current to the phase windings (U, V, W) of the stator.

7. The method as defined by one of the foregoing claims, characterized in that the control device (54), once the predetermined minimum value of the rotor rpm is attained, continuously

receives binary position signals for the rotor-position-dependent self-commutation of the motor via the comparator (52) with hysteresis.

8. The method as defined by one of the foregoing claims, characterized in that beyond a predeterminable value of the analog rotor position signal ($\int U_3$) furnished by the integrator (46), between its resting value (R) and an approximately sine-wave oscillation (S), the enabling of the change from the regulated initial supply of current to the phase windings (U, V, W) to the commutation regulation by the flanks of the binary output signal of the comparator (52) with hysteresis is effected, corresponding to the course of the third harmonic of the phase voltages.

9. The method as defined by one of the foregoing claims, characterized in that the enabling of the change from the regulated initial determination ($T_2 > T > 0$) of the phase windings (U, V, W) to the regulation by the output signal of the comparator (52) with hysteresis is effected upon the attainment of a first turning point (T_2) of the output signals ($\int U_3$) of the integrator (46).

10. The method as defined by one of the foregoing claims, characterized in that after the standstill position of the rotor (24) is ascertained, at least two phase windings (U, V, W) of the stator (22) are supplied with current at a starting value, such that between the axes of the rotor and stator magnetomotive force, an angle of 30°el. to 150°el., and preferably approximately 90°el., results.